CLAIMS

The invention claimed is:

1. A sole construction for use in a shoe, to support a foot by placing the foot in suspension within the shoe, wherein the shoe includes an upper and a base, the sole construction comprising:

a lattice composed of one or more high to medium modulus polymer or metal alloy materials, wherein the lattice is constructed to substantially conform to the contours of the sole of the foot, or a weight-bearing portion thereof; and,

scaffolding means attached to the lattice, wherein the scaffolding means maintain the lattice in suspension above the base of the shoe;

wherein the lattice carries the foot, or a weight-bearing portion thereof, in suspension above the base of the shoe.

2. The sole construction according to Claim 1, wherein the scaffolding means comprises a resilient annular frame having medial and lateral opposing sides attached to the lattice and adapted to fit along the inner perimeter of the upper; and further comprises support pillars extending downwardly from the annular frame.

3. The sole construction according to Claim 2, wherein one or more of the support pillars extend beneath the lattice to form a "U" shaped member having a bight seatable on the base of the shoe.

4. The sole construction according to Claim 1, wherein one or more regions of the lattice are carried by the scaffolding in a higher plane than other regions of the lattice.

5. The sole construction according to Claim 3, wherein one or more of the annular side members include rotation means to allow the side members, when disposed in the shoe, to move in a vertical plane adjacent to flex points in the foot.

6. The sole construction according to Claim 5, wherein the rotation means consists of a hinge, spring, piston, rotating pin, solenoid, or a flexible polymer member.

7. The sole construction according to Claim 6, wherein the flexible polymer consists of a closed cell polyurethane, ethylene vinyl acetate, or rubber.

8. The sole construction according to Claim 2, wherein the support pillars include means for shock absorption.

9. The sole construction according to Claim 2, wherein the support pillars include adjustment means for allowing portions of the frame to be raised and lowered to set heights within the shoe.

10. The sole construction according to Claim 1, wherein the lattice is removably attached to the scaffolding.

11. The sole construction according to Claim 10 wherein the scaffolding further includes a removable annular rim, and the lattice is attached to said removable annular rim.

12. The sole construction according to Claim 1, wherein the lattice is permanently attached to the scaffolding.

13. The sole construction according to Claim 12, wherein the lattice is constructed of interwoven fibers, and each of said fibers is secured to the scaffolding by insertion through a grommet disposed in the annular frame.

14. The sole construction according to Claim 1, wherein the lattice is integrally formed as part of the scaffolding.

15. The sole construction according to Claim 14, wherein the lattice is co-molded with the scaffolding.

16. The sole construction according to Claim 1, further including energy return means for absorbing energy from compression during gait, and releasing the energy when the compression ends; wherein said energy return means are disposed adjacent to the lattice at points therein adapted to carry weight-bearing portions of the foot.

17. The sole construction according to Claim 16, wherein the energy return means comprise distinct portions of the lattice, wherein said distinct portions are under a greater relative tension than adjacent portions of the lattice.

18. The sole construction according to Claim 16, wherein the energy return means comprise closed cell foam material or fluid-filled capsules incorporated within distinct portions of the lattice.

19. The sole construction according to Claim 1, wherein the fibers are medium modulus fibers.

20. The sole construction according to Claim 19, wherein the medium modulus fibers comprise a composite of polyetramethylene terephthalate polyester and polytetramethylene ether.

21. The sole construction according to Claim 20, wherein the medium modulus fibers consist of Hytrel®.

22. The sole construction according to Claim 21, wherein the Hytrel® has a modulus of at least about 10 MPa, at 100°C, elongation to break at 375%, and tensile strength of at least 31 kpsi.

23. The sole construction according to Claim 19, wherein the medium modulus fibers run in the warp direction of the woven lattice.

24. The sole construction according to Claim 23, wherein the medium modulus fibers also run in the weft direction of the woven lattice.

25. The sole construction according to Claim 23, wherein the fibers running in the weft direction of the lattice are high modulus fibers.

26. The sole construction according to Claim 23, wherein the fibers running in the weft direction of the lattice are low modulus fibers.

27. The sole construction according to Claim 1, wherein the polymer fibers are high modulus polymer fibers.

28. The sole construction according to Claim 27, wherein the high modulus fibers are selected from the group of such fibers consisting of nylon, carbon fibers, liquid crystalline polymers, aramid polymers, and lightweight metal alloys.

29. The sole construction according to Claim 19, wherein the lattice is further comprised of interwoven low modulus fibers.

30. The sole construction according to Claim 27, wherein the lattice is further comprised of interwoven low modulus fibers.

31. The sole construction according to Claim 29 or Claim 30, wherein the low modulus fibers are selected from the group of such fibers consisting of spandex,

extrudable aromatic polyesters, upholstery grade fibrous yarns, microfibre yarns, and non-extrudable polyester yarns.

32. The sole construction according to Claim 1, wherein the lattice includes (a) a forefoot region consisting of a forward aspect to extend distally from the metatarsal heads of the foot, and a rearward aspect to underlie the metatarsal heads of the foot; (b) a midfoot region extending proximally from the ball of the foot toward the heel, which midfoot region has medial and lateral aspects ; and (c) a heel region.

33. The sole construction according to Claim 32, wherein the medial aspect of the midfoot region is formed of a high modulus polymer or metal, and the lateral aspect of the midfoot region is formed of a medium modulus polymer.

34. The sole construction according to 32, wherein the heel region includes a concavity therein adapted to receive the heel of a foot, and said concavity is formed of a high modulus polymer or metal; wherein further portions of the heel region adjacent to the concavity are formed of a medium modulus polymer.

35. The sole construction according to Claim 32, wherein the rearward aspect of the forefoot region is formed of a high modulus polymer, and the forward aspect of the forefoot region is formed of a medium modulus polymer.

36. The sole construction according to Claim 32, wherein the fibers of the medial aspect of the midfoot region is woven at a density greater than 20 threads per square inch; and the fibers of the lateral aspect of the midfoot region is woven at a density of 20 threads per square inch, or less.

37. The sole construction according to Claim 32, wherein the heel region includes a concavity therein adapted to receive the heel of a foot, and the fibers of said concavity are woven at a density greater than 20 threads per square inch; and the

fibers of the portion of the heel region adjacent to the concavity are woven at a density of 20 threads per square inch, or less.

38. The sole construction according to Claim 32, wherein the fibers of the rearward aspect of the forefoot region are woven at a density greater than 20 threads per square inch; and the fibers of the forward aspect of the forefoot region are woven at a density of 20 threads per square inch, or less.

39. The sole construction according to Claim 1, wherein the fibers running in the warp direction of the lattice are under higher relative tension than the fibers running in the weft direction of the lattice.

40. The sole construction according to Claim 32, wherein the density of the fibers in the lattice varies among its regions.

41. The sole construction according to Claim 32, wherein the composition of the fibers in the lattice varies among its regions.

42. The sole construction according to Claim 32, wherein the relative tension placed on the fibers in the lattice varies among its regions.

43. The sole construction according to Claim 32, wherein the medial aspect of the midfoot region of the lattice is adapted to receive the arch of a foot, and is suspended in a higher plane than the lateral aspect of the midfoot region of the lattice.

44. The sole construction according to Claim 32, wherein the forward portion of the forefoot region of the lattice is adapted to receive the metatarsal heads of a foot, and is suspended in a higher plane than the rearward portion of the forefoot region of the lattice.

45. The sole construction according to Claim 2, wherein the annular frame is adapted to fit along the lateral and medial aspects of a forefoot region of a foot, and the lattice consists of a forefoot region consisting of a forward portion distal to the ball of the foot, as well as a rearward portion underlying the ball of the foot; and wherein further a portion of the forward portion of the lattice is adapted to receive the metatarsal heads of a foot, and is suspended in a higher plane than the rearward portion of the lattice.

46. The sole construction according to Claim 2, wherein the annular frame is adapted to fit along the lateral and medial aspects of a midregion of a foot extending proximally from the ball of the foot toward the heel; and wherein further the medial aspect of the mid-region of the lattice is adapted to receive the arch of a foot, and is suspended in a higher plane than the lateral aspect of the mid-region of the lattice.

47. A shoe having an improved sole construction, the shoe comprising an upper, a base, and the improved sole construction of Claim 1.

48. The shoe according to Claim 47, wherein the scaffolding means comprises a resilient annular frame having medial and lateral opposing sides attached to the lattice.

49. The shoe according to Claim 48, wherein the resilient annular frame is adapted to fit along the inner perimeter of the upper; and further comprises support pillars extending downwardly from the annular frame.

50. The shoe according to Claim 48, wherein the resilient annular frame is an integral part of the shoe upper, so the scaffolding and shoe upper form a unitary structure.

51. The shoe according to Claim 49, wherein the support pillars extend beneath the lattice to form a "U" shaped member having a bight seatable on or under the base of the shoe.

52. The shoe according to Claim 49, wherein the support pillars securely engage the base of the shoe to retain the sole construction in place therein.

53. The shoe according to Claim 48, further including energy return means for absorbing energy from compression during gait, and releasing the energy when the compression ends; wherein said energy return means are incorporated within the base of the shoe at one or more locations therein.

54. The shoe according to Claim 53, wherein the energy return means comprise closed cell foam material or fluid-filled capsules.

55. A method for manufacture of a shoe having an upper, a base, and an improved sole construction, the method comprising forming the sole construction of Claim 1 as a unitary part of the shoe upper, then securing the upper to the shoe base.

56. The method according to Claim 55, wherein the sole construction and upper are co-molded.

57. The method according to Claim 55, wherein the upper is constructed of a layered fabric, and the annular frame of the sole construction is encompassed between two layers of the upper fabric

58. A method for manufacture of a shoe having an upper, a base, and a lattice secured to the upper, wherein the lattice is composed of one or more high to medium modulus polymer or metal alloy materials, and the lattice is constructed to substantially conform to the contours of the sole of the foot, or a weight-bearing portion thereof; the method comprising securing the lattice to the upper, and securing the upper to the base, so that the lattice carries the foot, or a weight-bearing portion thereof, in suspension above the base of the shoe.